

Single electrons from semileptonic charm meson decays in pp collisions at 200 GeV

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for the PHENIX Collaboration

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Why Charm in p+p Collisions @ RHIC

Charm production mainly through gluon-gluon fusion and quark-antiquark annihilation. Quark-gluon scattering also involved at higher order.

Charm measurement intrinsically interesting.

Reference to understand:

- **charm production in heavy ion collisions**
probe of initial state and state of nuclear medium
- **J/ Ψ suppression in heavy ion collision**
one of signature of QGP

PHENIX in Run2 p+p at 200 GeV

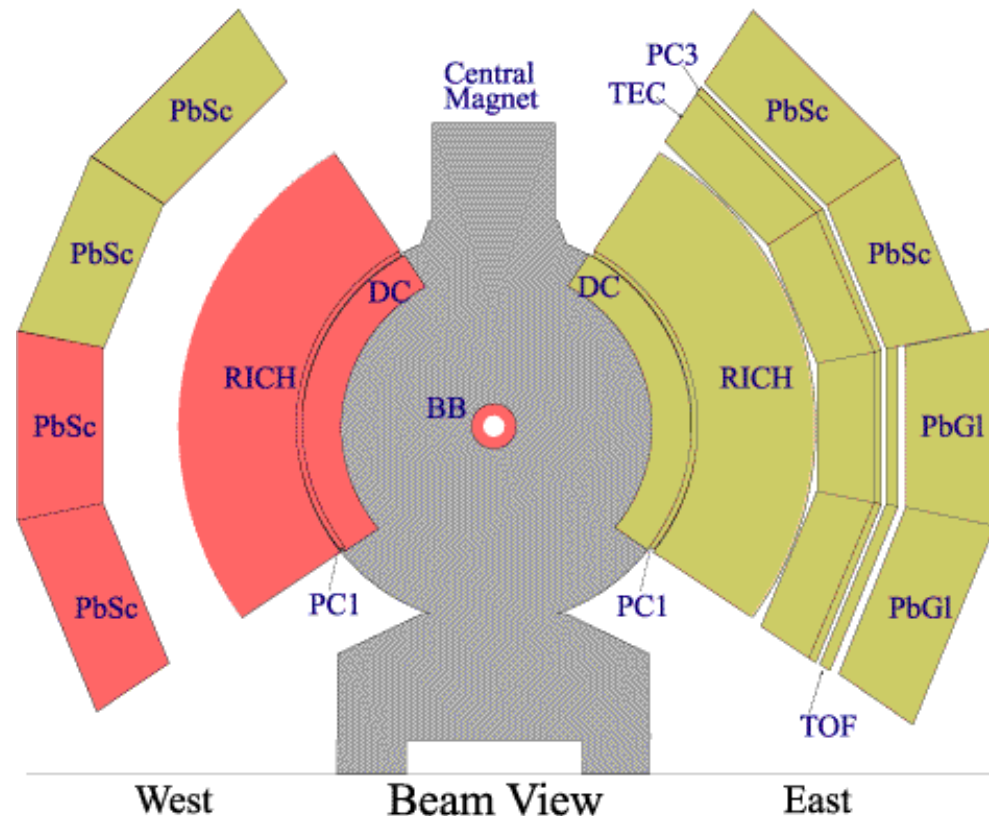
This analysis uses:

15M MiniBias events in $|Z_{\text{vertex}}| < 25$ cm

465M sampled events by Level1 Trigger

For electron measurements

- BBC: vertex position, trigger
- DC, PC1: tracking
momentum measurement
- RICH: electron ID
- PC3: charge veto for photon ID
- EMCal: electron ID
energy measurement

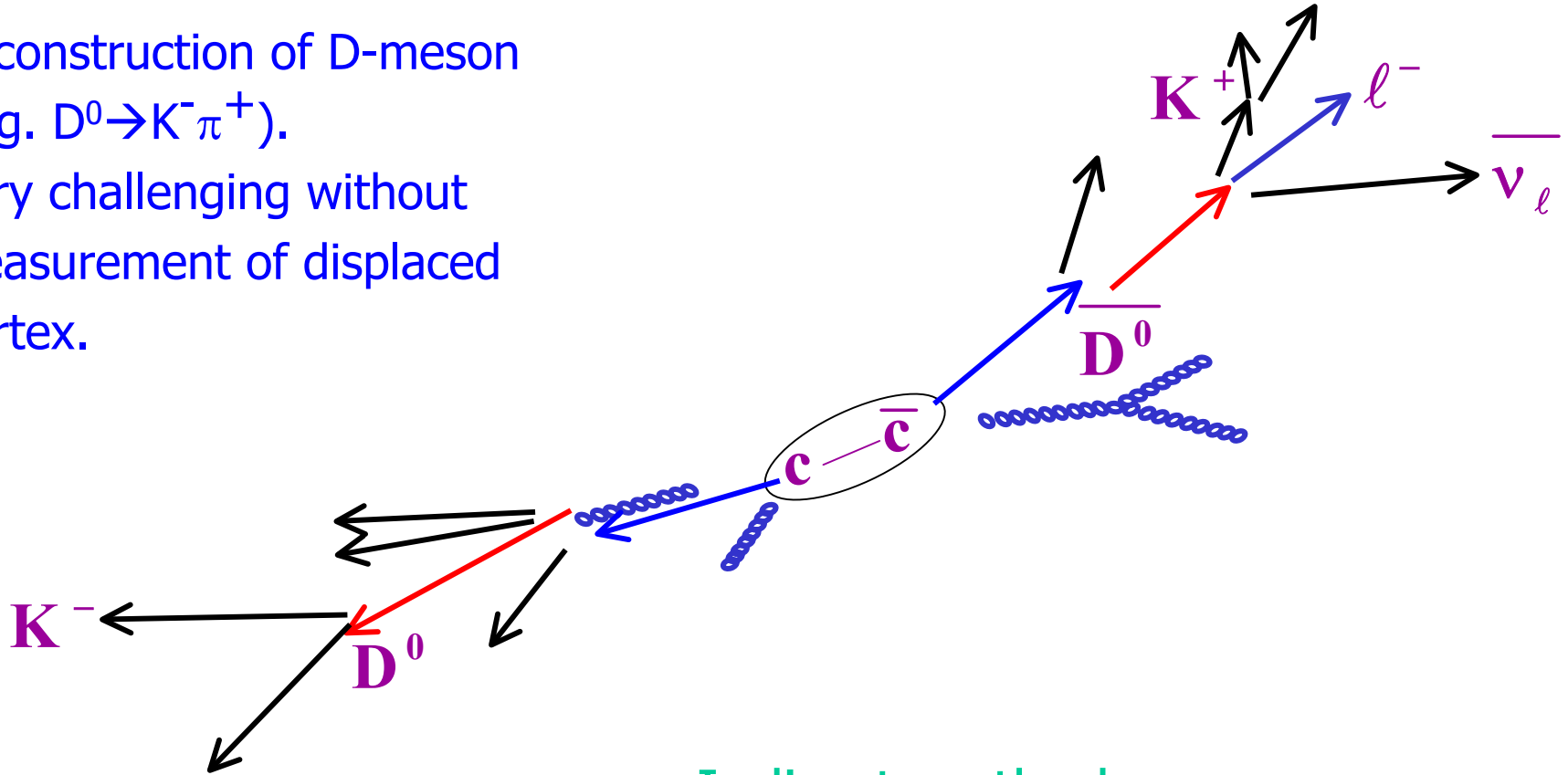


How to detect Charm

Direct method:

Reconstruction of D-meson
(e.g. $D^0 \rightarrow K^- \pi^+$).

Very challenging without
measurement of displaced
Vertex.



Indirect method:

Measure leptons from semi-leptonic decay of charm mesons.
Used at PHENIX.

Challenging at PHENIX

Charm $e/\pi \sim 3\text{-}4 \times 10^{-4}$ *expected in $p+p$ @ 200 GeV*

Backgrounds

$$\pi^0 \rightarrow e^+e^- \gamma$$

Dalitz: Branching Fraction=1.2%

$$\pi^0 \rightarrow \gamma \gamma$$

$$\downarrow \rightarrow e^+e^-$$

Conversion: comparable to Dalitz

$$\eta \rightarrow e^+e^- \gamma$$

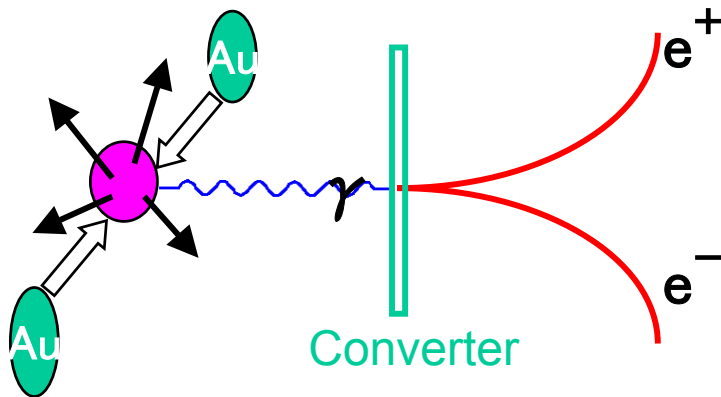
$$\eta \rightarrow \gamma \gamma$$

$$\downarrow \rightarrow e^+e^-$$

20% of π^0 contribution at high pt

Others small, e.g. K , ρ , ω , η' , ϕ decays

Three approaches at PHENIX



Photon converter method:
requires good statistics of
dedicated converter run

Cocktail method: needs full knowledge of π^0 spectrum

GC.010 Sergey Butsyk

(e, γ) coincidence method: π^0 yield not necessary

this talk

Way to charm signal

Simulate π^0 decays according to PDG

$$Br(\pi^0 \rightarrow \gamma \gamma) = 98.8\%$$

$$Br(\pi^0 \rightarrow \gamma e^+ e^-) = 1.2\%$$

Reconstruct π^0 by (e, γ) coincidence

Calculate $R = \text{coincidence} / \text{electron inclusive}$

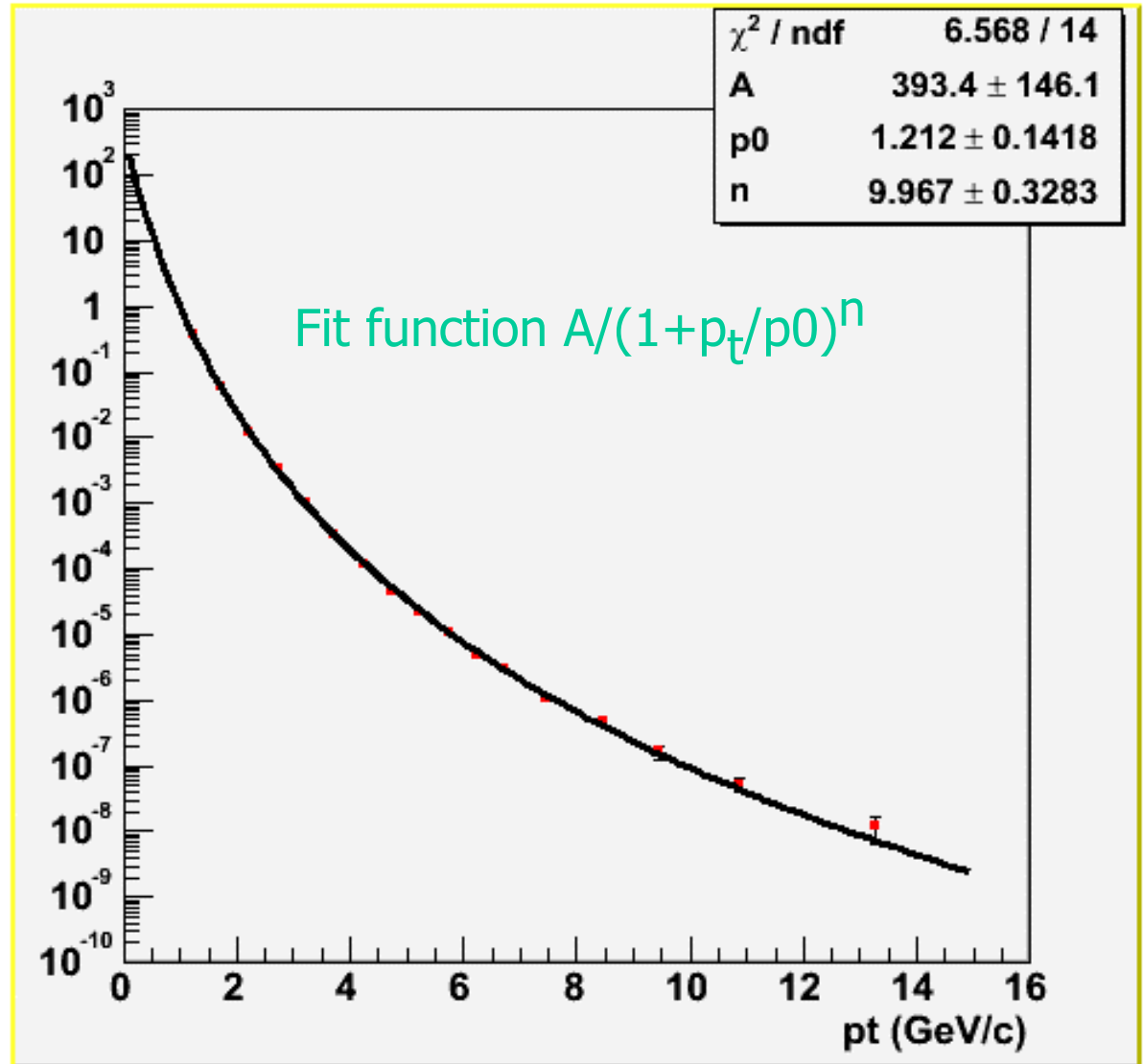
non- π^0 related / electron inclusive

$$= 1 - R(\text{data}) / R(\text{simulation})$$

Simulation input

π^0 is well
measured at
PHENIX for p+p
@ 200 GeV
hep-ex/0304038

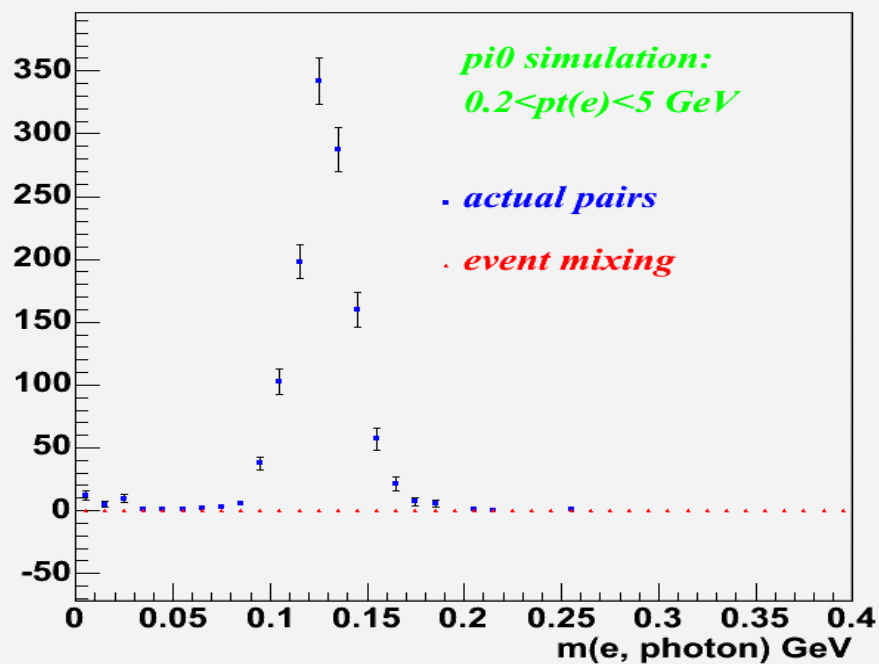
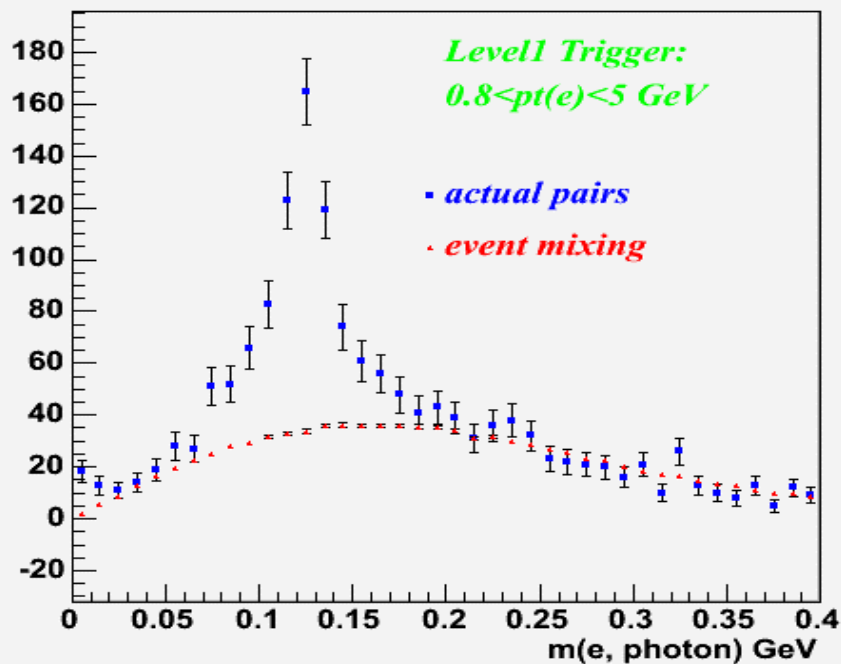
absolute
normalization
(A) is not used
in simulation



(e, γ) coincidence

internal/external γ conversion: $\pi^0 \rightarrow \gamma e^+ e^-$

Reconstruct π^0 from (e, γ) coincidence
 η also possible in high statistics



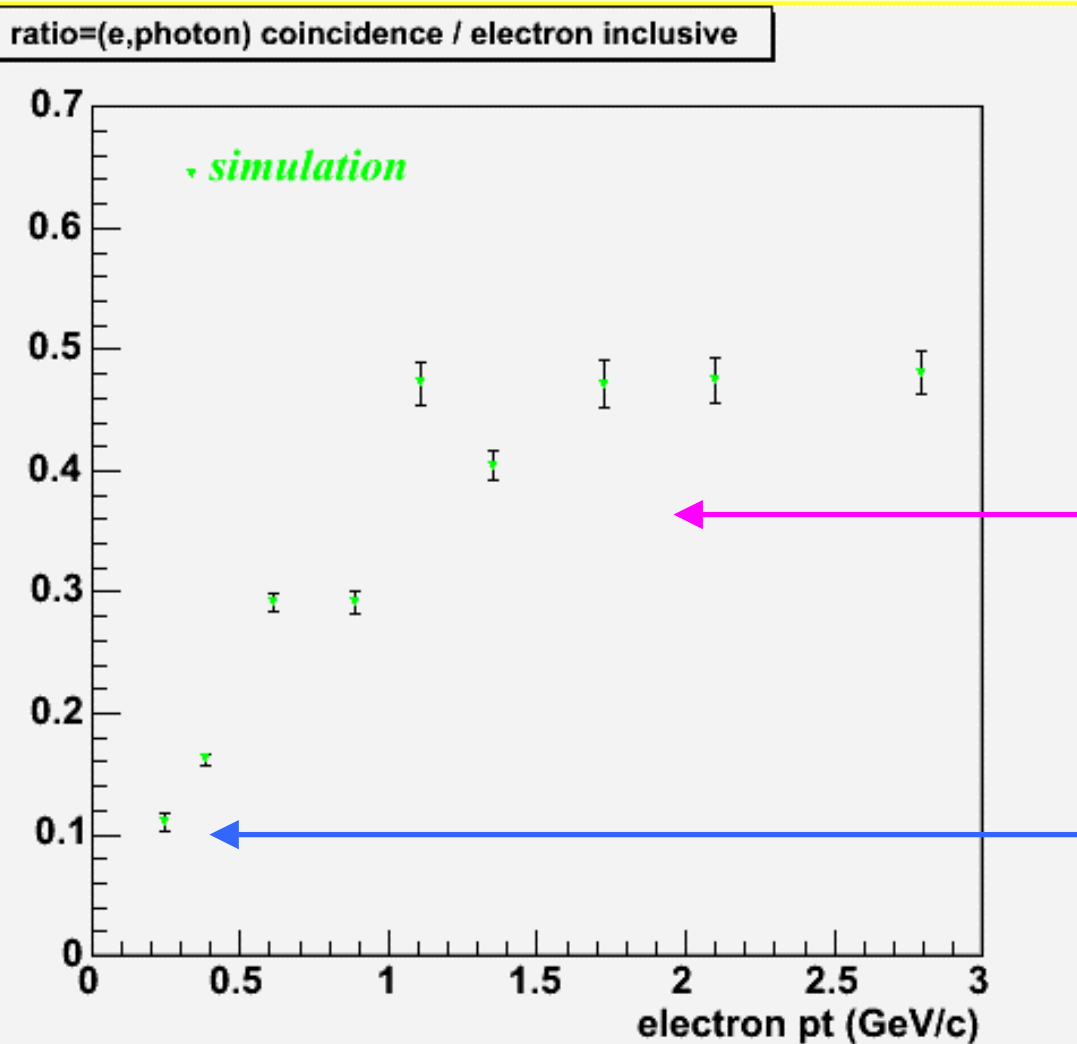
Rate of (e, γ) coincidence

coincidence
increases with p_t
due to less
bending in field

no coincidence from
charm meson decays

data < simulation
at high p_t

no charm expected
to be seen at low p_t
data = simulation



Outlook

New method to extract electron signal from Charm/Bottom meson decays

**Robust: require knowledge only of π^0/η slope
absolute normalization not necessary**

Will finalize PHENIX Run2 pp data analysis

Applicable to dAu, AuAu data analysis